

Recurrent Aberration in *Cynthia annabella*
A Review with Four New Records

(Lepidoptera: Nymphalidae)

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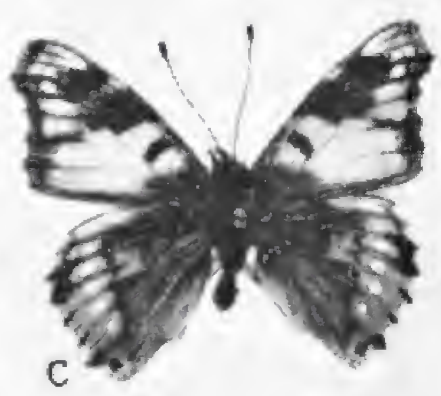
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Three species of Painted Lady butterflies occur in California: *Cynthia annabella* Field = *C. carye* of authors, *C. cardui* Linnaeus, and *C. virginiensis* Drury. All produce aberrant phenotypes characterized by suppression of the discal wing pattern, fusion of the subapical dark pattern elements, and development of a series of white submarginal spots. These phenotypes were named in all three species, mostly in the heyday of aberration naming in the first three decades of this century. They attracted a great deal of attention because of their remarkable similarity in the three related species and because they occurred with exceptional frequency considering their drastic nature. When Grinnell described "*Vanessa caryae* (sic!) var. *intermedia*" and "var. *letcheri*" (Grinnell, 1918) he had before him three and nine specimens respectively, in addition to four of the similar "var. *muelleri*"—all but three northern California, and all collected between 1911 and 1917.

The record of these and similar aberrations in the literature is extensive, and may be traced in the bibliographies given by Field (1971) under the following names; in *C. cardui*: *elymi* Rambur, *emielymi* Verity, *hemielymi* Gaede; in *C. virginiensis*: *ahwashtee* Fox; in *C. annabella*: *muelleri* Letcher, *intermedia* Grinnell, *letcheri* Grinnell, *schraderi* Gunder. The oldest records are of *C. cardui* "aberration *elymi*," which has been known since the early nineteenth century and was figured clearly from England by Newman (1874). In *C. annabella* this type of variation was first described by Letcher (1898) ("var. *muelleri*"). Subsequently Grinnell (1918) named "var. *intermedia*" and "var. *letcheri*," less and more extreme manifestations of the same tendency, and Gunder (1929) named yet another member of the series "transition form *schraderi*." All of these are infrasubspecific names and have no standing in formal zoological nomenclature. They were, however, extensively discussed and numerous specimens were figured by Gunder (1925, 1927a, 1927b, 1929) and Comstock (1927). Most published records—about 35—date from this period. The unsavory reputation of aberration naming led to a decline in published records. One recent record is by Phillips (1971) of a "*muelleri*" from Salt Lake City, Utah,



a



c

1



b



d



a



c

2



b



d

near the eastern edge of the range of *C. annabella*. There is no evidence that the actual incidence of these phenotypes has decreased—only the level of interest in them. They are, however, no better understood today than forty years ago.

Speculation on their evolutionary significance diverged. Grinnell was of the opinion that they had arisen in *C. annabella* quite recently and were increasing in frequency in the species. He interpreted their occurrence in the three species as an example of orthogenesis. Gunder and Comstock, conversely, interpreted it as a primitive trait derived from a common ancestor—a case of reversion or “atavism.” The extreme similarity of the phenotypes leaves little doubt that they are homologous in origin, but whether they are parallel developments or persistent from a common ancestor remains unknown. No living species of *Cynthia* or its near relatives has a normal pattern anything like that of any of them.

Dimock (1968) reported the induction of “*elymi*” in *C. cardui* by chilling fresh pupae for 14 days at 36° F. As Grinnell noted, however, the aberrant phenotypes have been taken in the summer months when chilling to the requisite degree would be very unlikely in the collection localities. Either Dimock’s specimens are phenocopies and the wild ones are produced genetically without the intervention of an abnormal environment, or else the phenotypes can be produced by more than one kind of stress. The largest number of captures in *C. annabella* is in September and October, but there are records for every month but January, March, April, and December.

I have taken three fresh aberrant *C. annabella* in the Sacramento Valley in nine months, the first such cluster of captures reported in some forty years. The records are: Willow Slough, 2.5 miles NE Davis, Yolo County v-10-72 (figs. 1a, 2a); Putah Creek Recreation Area, 3 miles SW Davis, Yolo County xi-17-72 (figs. 1b, 2b); American River basin, North Sacramento, Sacramento County ii-18-73 (figs. 1c, 2c). In addition, another specimen of slightly less aberrant phenotype was taken at Suisun City, Solano County on v-19-72 (figs. 3a, b). The pattern shown by this individual, while clearly related to the others, is unlike

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FIGS. 1–2. *Cynthia annabella* aberrations discussed in text. Fig. 1. Dorsal surfaces: a, Yolo County, California, v-10-1972; b, Yolo County, xi-17-1972; c, Sacramento County, ii-19-1972; d, slightly aberrant individual, Yolo County, iii-7-1973. Fig. 2. Ventral surface of above specimens.



FIG. 3. Dorsal and ventral surfaces of slightly aberrant individual, Suisun City, Solano County, v-19-1973.

any specimen previously figured. These were among about 3800 wild *C. annabella* examined for beak marks during this period in the course of a predation-frequency study. The only other specimen showing the slightest variation in this direction is shown in figures 1d and 2d. It was taken at Putah Creek on iii-7-73, fresh from the pupa, and shows a very minor reduction of the discal markings on the forewings. About 100 other individuals of fresh *C. annabella* were examined in January, February, and early March after the very cold 1972-73 winter, but none was abnormal.

Postulating that the aberrant phenotypes of *C. annabella* are produced by a single recessive allele whose genotypic frequencies follow the Hardy-Weinberg law, the homozygote frequency would be 0.001 and the gene frequency 0.032. About six per cent of the hypothetical population would be heterozygous carriers. Such frequencies could not be maintained by mutation alone and would have to be considered a polymorphism. If the mutant allele were dominant, the Hardy-Weinberg law would give a gene frequency of 5×10^{-4} , a figure within the range of reasonable mutation rates. If dominance is an evolved characteristic, as is generally believed, then if the aberrant phenotypes of *C. annabella* and its relatives were due to a dominant, recurrent mutation this would be strong evidence for the "atavism" interpretation—reflecting the persistence of previously selected dominance modifiers, a condition called by E. B. Ford and his colleagues "paleogenic."

LITERATURE CITED

- COMSTOCK, J. A. 1927. Butterflies of California. Author, Los Angeles. 334 p.
 DIMOCK, T. 1968. An extreme experimental aberration of *Vanessa cardui* (Nymphalidae). J. Lepid. Soc. 22: 146.

- FIELD, W. D. 1971. Butterflies of the genus *Vanessa* and of the resurrected genera *Bassaris* and *Cynthia* (Lepidoptera:Nymphalidae). *Smithson. Contrib. Zool.* 84: 1-105.
- GRINNELL, F., JR. 1918. Some variations in the genus *Vanessa* (*Pyrameis*). *Psyche* 25: 110-115.
- GUNDER, J. 1925. Several new aberrant Lepidoptera. *Entomol. News* 36: 193-200.
- 1927a. New transition forms or "abs" and their classification (Lepid., Rhopalocera). *Entomol. News* 38: 129-138.
- 1927b. Transition forms (Lepid., Rhopalocera). *Entomol. News* 38: 263-271.
1929. An addition to *Cynthia carye* Hubner (Lepidoptera, Nymphalidae). *Pan-Pac. Entomol.* 6: 9.
- LETCHER, B. 1898. Variation of *Pyrameis carye* Hubner. *Entomol. News* 9: 38.
- NEWMAN, E. 1874. *An Illustrated Natural History of British Butterflies and Moths.* David Bogue, London. 486 pp.
- PHILLIPS, W. L. 1971. Rare aberrant forms of Utah *Cynthia*, the Painted Lady (Lepidoptera: Nymphalidae). *Great Basin Natur.* 31: 256-260.